

Natural Lead Neutron Reactions Evaluation

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Natural Lead Neutron Evaluation

- Evaluate natural lead for novel fast systems [1][2]
- RPI Scattering Data discrepancy from ENDF-8 [3][4]
- Benchmarking against
 - ICSBEP Handbook Experiments[5]
 - RPI scattering data
 - LSDS Measurements

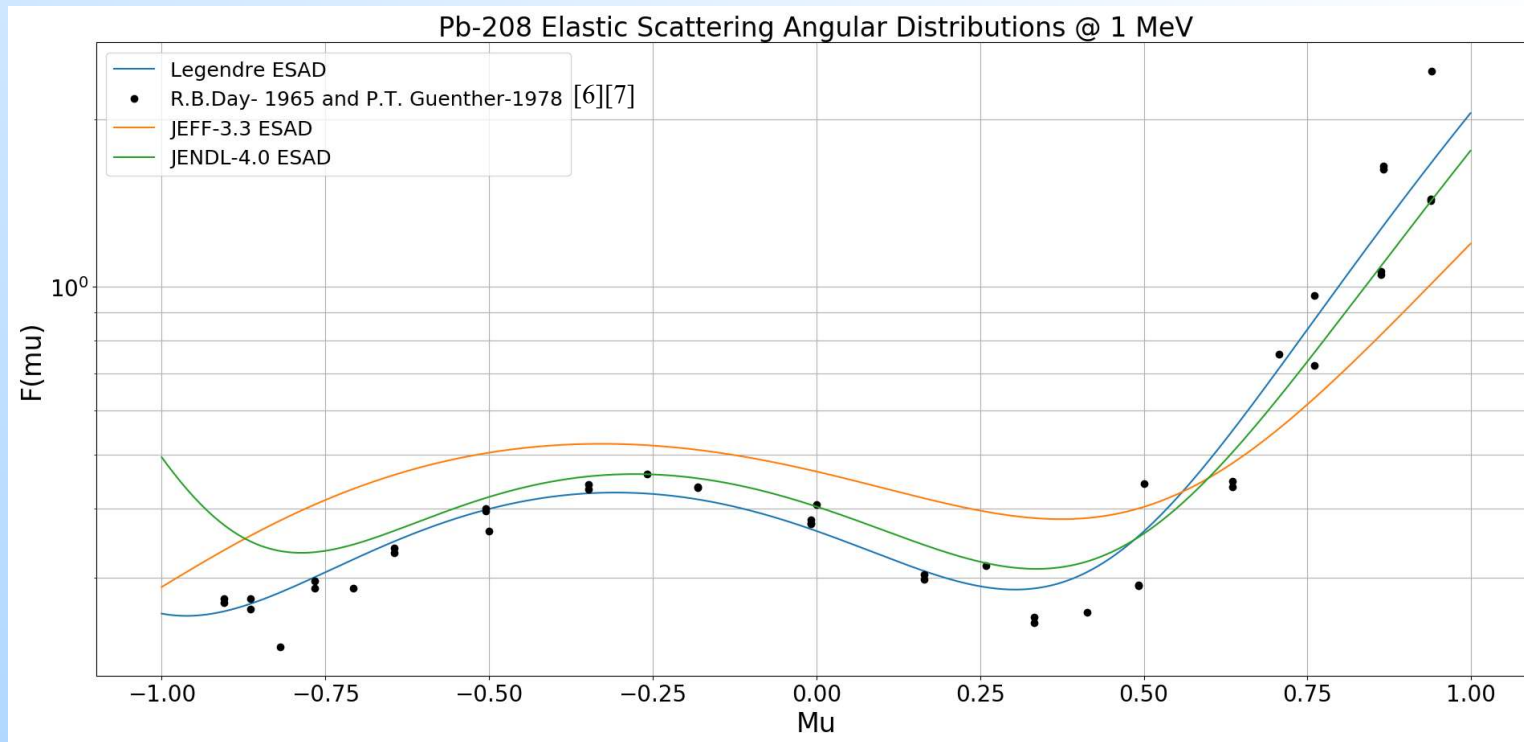
Table I - The isotopes of Pb, abundance and *upper* boundary of the RRR

Isotope	Abundance [%]	ENDF/B-8.0 end of RRR [MeV]	s-wave level density (D_0) [keV]
Pb-204	1.4	0.050	2.172
Pb-206	24.1	0.900	37.1
Pb-207	22.1	0.475	30
Pb-208	52.5	1.000	400



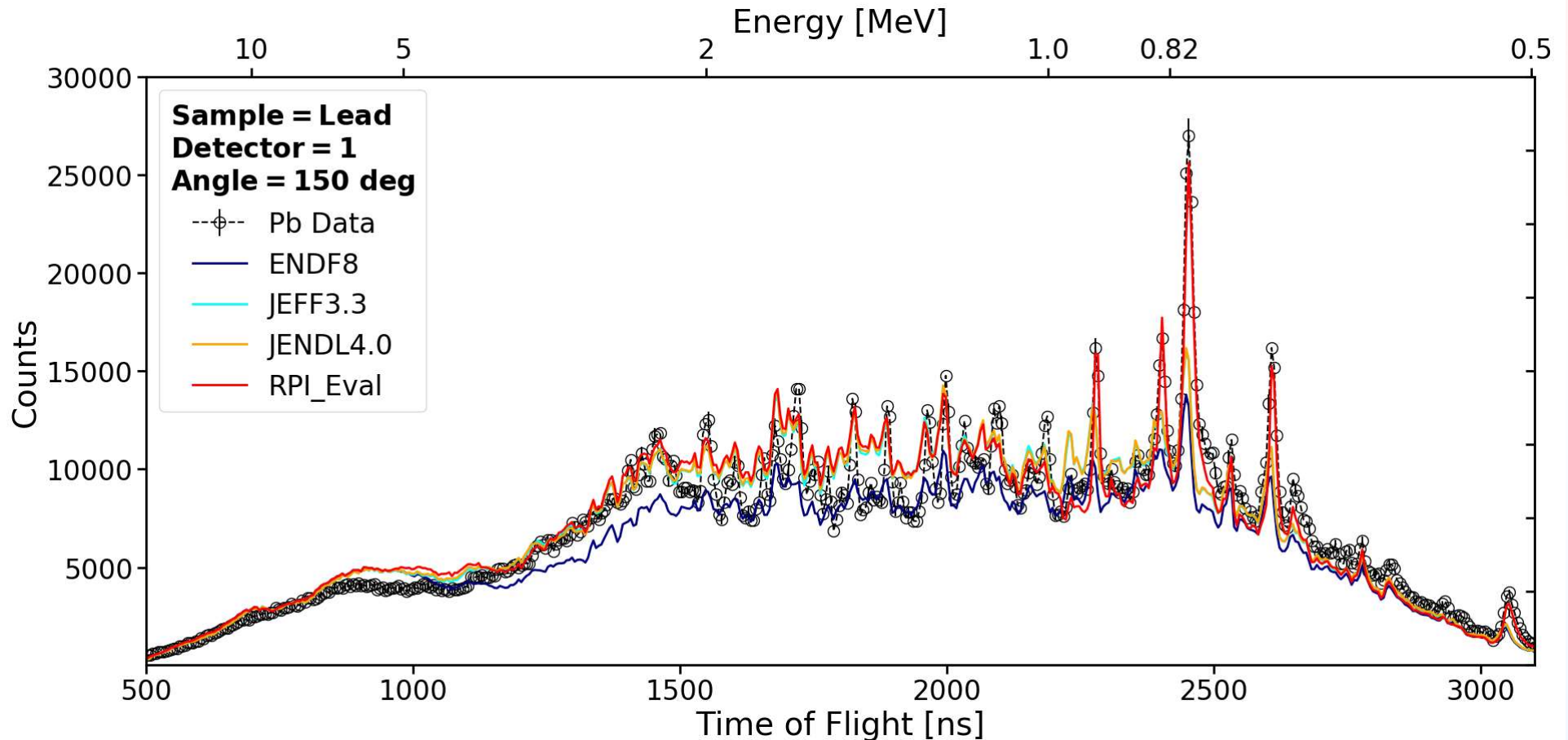
Criticality Benchmarks

- Pb-208 has largest overall sensitivities in DICE
- JEFF and JENDL calculate $K_{eff} C/E > 1$ and ENDF < 1
- Cross Sections for evaluations are the same \rightarrow Angular Distributions (AD)
- Blatt-Biedenharn treatment for Elastic Scattering AD (ESAD) in RRR and Legendre polynomial representation of EXFOR data in Fast Region.



Quasi-Differential Scattering Measurements

- BB Formalism < 1 MeV enables full resonances to be seen.
- Custom ESAD above $1 > 1$ MeV allows for 2-5 MeV to fit better than ENDF-8.



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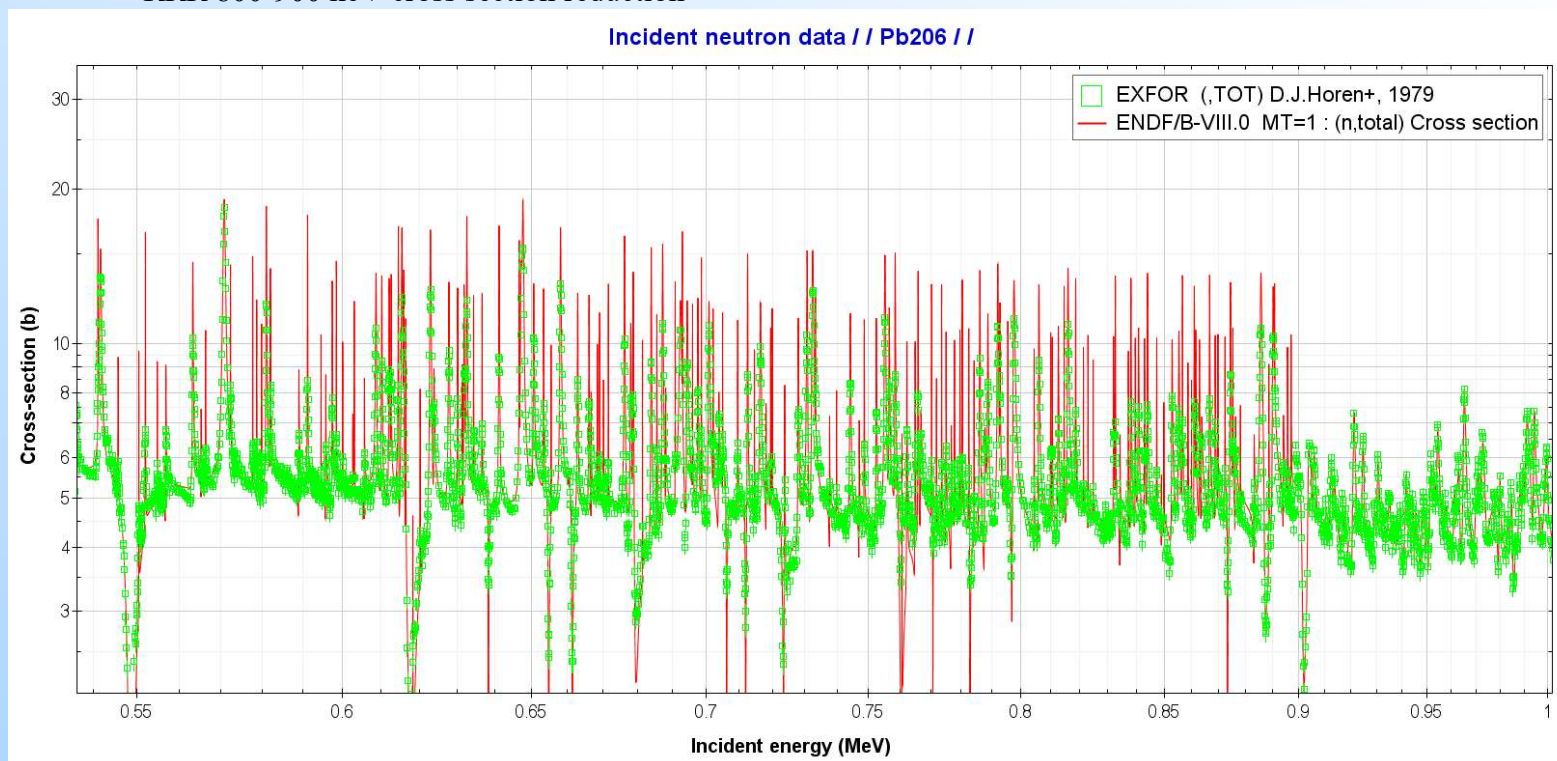


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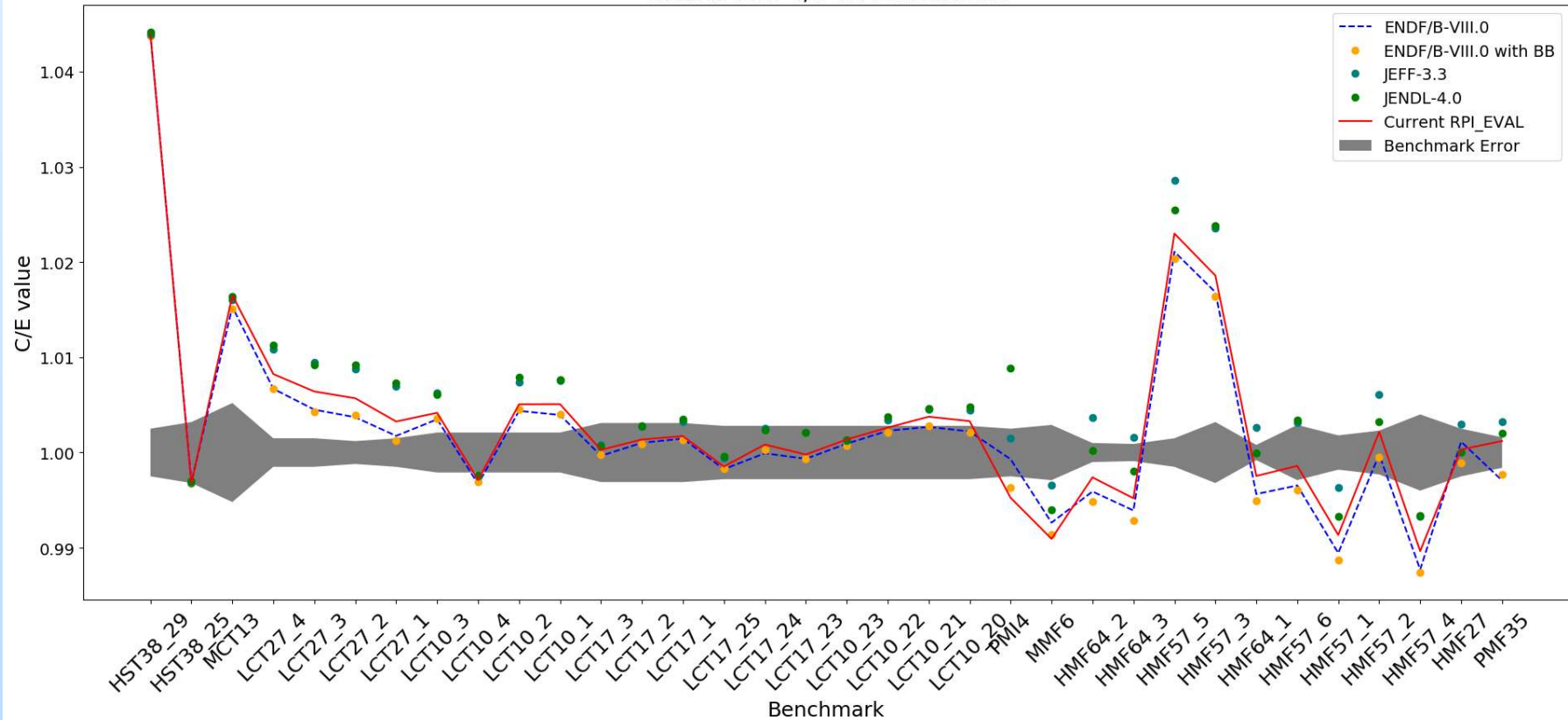
Areas of Evaluation

- **Pb-208**
 - Elastic Scattering Angular Distribution in RRR and Fast Region
 - Capture Cross Section for Epithermal Range
 - RRR extension to 2 MeV for angular distributions.
- **Pb-207 (future work)**
 - RRR extension up to 600 keV
- **Pb-206 (future work)**
 - RRR 800-900 keV cross section reduction



Benchmark Results

Critical Keff C/E vs. Benchmark



References

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4. Amanda E. Youmans, J. Brown, A. Daskalakis, N. Thompson, A. Wetz, Y. Danon, B. McDermott, G. Leinweber and M. Rapp, "Fast Neutron Scattering Measurements with Lead", AccApp 15, Washington, DC, pp. 355-360, November 10-13 2015.
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6. P. T. Guenther, D. G. Havel and A. B. Smith, Neutron Scattering and the Optical Model near A = 208 and Implications on the Inelastic Scattering Cross Section of Uranium-238, Nuclear Science and Engineering, 65:1, 174-180, DOI: 10.13182/NSE78-A27140, 1978.
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